The examiner refers to U.S. 4,794,471 as teaching roll forming of a clad tubing by inserting a mandrel into a subassembly of two hollow cylindrical workpieces 10, 14 wherein roll forming the clad tubing uses a bank of opposing rolls to metallically bond the workpieces. The workpieces have radial play when inserted into one another as disclosed in col. 3, lines 9-14, and col. 4, lines 43-52, of U.S. 4,790,471. In examiner's opinion it would have been obvious to use the setup of U.S. 4,794,471 in axial roll forming an annular composite workpiece in accordance with applicant's admitted prior art in order to achieve an excellent metallic bond between the workpieces.

Applicant would like to submit, that the present invention relates to cold rolling where two rings are to be combined to a composite by axial roll forming. As regards axial roll forming reference is being had to the explanation provided in the last paragraph of the instant specification where with the aid of Figs. 9 and 10 the axial roll forming action of the present invention is explained. Thus, in accordance with the present invention the cold rolling method is an axial roll forming process that by definition causes an elongation in the axial direction of the tubular members as a result of the shaping (forming) action. It is also set forth in the specification that the high pressure used for the axial roll forming process causes the fixed connection like a cold pressure weld between the two workpieces, thus a composite (page 2, second to last paragraph of the specification).

It is furthermore respectfully submitted that the applicant's admitted prior art, as set forth in the specification, concerns DE 2745527 cited in the international search report. As evidenced by the international search report, DE 2745527 has a US equivalent which is US 4,189,816 submitted with the Information Disclosure Statement of January 5, 2006.

Therefore, to properly evaluate applicant's admitted prior art, reference is being had to US 4,189,816. This reference discloses the manufacture of a bearing race from two blanks 5 and 6 by cold rolling. The method is set forth in col. 3, lines 9-45, of U.S. 4,189,816:

"The method of fabricating the bearing race is as follows: the outer ring 2 is realized starting from a blank 5 (FIG. 3) by a known technique using the operations of turning or punching. The outer diameter A and the width C of the blank 5 are slightly less than the outer

diameter B and the width D of the ring 2, respectively. The diameter E of the hole through the blank is slightly less than the outer diameter F of the blank 6 for the inner ring 1. The blank 6, shown in FIG. 4, made of bearing steel of type 100 c6 can likewise be formed by turning or punching or by rolling strips into rings and welding them together. The width K of the blank 6 is slightly less than the width C of the blank 5 for the outer ring 2. On the other hand, its outer diameter F is slightly greater than the diameter E of the hole in the blank 5."

„**The two blanks 5 and 6 are then mated in the press**, one inside the other as shown in FIG. 5, and the faces of the inner blank 6 are at equal distances from those of the outer blank 5. The dimensional proportions between the two blanks 5 and 6 are chosen so as to make the sum of their weights equal to that of the composite race."

„**The two blanks, assembled concentrically, then form a unit which is to be deformed radially.** The rolling operation as shown in FIGS. 6 and 7 is performed while the outer blank 5 is confined in a support made up of two separable shells 7 and 8, the inner dimensions of which are equal to the outer diameter B and the thickness D of the race being made. A suitably shaped roller 9 of profile corresponding to that of the ball grooves is driven in rotation and in translation towards the blank **6. In the course of the rolling process the blanks 5 and 6, under the action of the pressure exerted by the roller 9, deform axially and radially** until they completely fill a cavity 10 in the support bounded by the separable shells 7 and 8. "

Thus, applicant's admitted prior art sets forth, in essence, that two annular blanks are pressed into one another (the outer diameter of the inner ring is greater than the inner diameter of the outer ring) and the unit of press-fit rings is then cold rolled in a stationary outer mold 7, 8 by a roller 9 that exerts pressure onto the inner ring and slowly deforms the rings as shown in Figs. 6 and 7. The radial pressure causes axial and radial deformation as is apparent when looking at Fig. 6 (before) and Fig. 7 (after). However, it is also set forth in the specification, paragraph bridging pages 1 and 2, that the bond between the rings is unsatisfactory.

The reference U.S. 4,794,471 cited by examiner for its roller set-up relates to **a process of liquid interface diffusion bonding** (see col. 1, lines 47-50). This method discloses that an inner tubular cladding member 14 is inserted into a **plated** host

member.

Plating means that the host member is provided at its internal surface 10A with a layer of a low melting point bonding metal alloy 12 (col. 2, lines 59ff). Such metal alloys are disclosed in col. 2, lines 65ff). After the cladding member 14 has been inserted, the first end 14B of the cladding member 14 is welded (weld 18) to the host member 10, i.e., the two members are securely connected to one another circumferentially and cannot be moved relative to one another. In fact, the welding step is necessary in order to provide an airtight seal. The weld is also structural and transfers stress between the two cylinders (col. 3, lines 29-45). The annular space 20 between the two tubular members 10, 14 must be free of oxygen and water vapor and is therefore evacuated and filled with an inert gas (col. 3, lines 46-53) in a very complicated sequence of steps requiring further welding (26). The method is so complex that:

"It is imperative that the annular space 20 between the interior surface of the host pipe and the exterior surface of the cladding member be substantially free of water and oxygen. By "substantially free" is meant that the space should be under conditions such that the water and oxygen dew point is at -60° F. or below. To achieve this result the space may have to be evacuated, filled with inert gas, evacuated and refilled several times. When the water and oxygen levels in the annular space have been reduced to the accepted level the pressure of inert gas remaining in the annular space can be relatively low and preferably is that which is sufficient to help support the bag, that is resist collapsing of the bag, during the subsequent steps of heating and rolling the subassembly."

The cited reference is based on a very specific process of bonding by means of a **bonding alloy applied between the inner and outer tubular members** that requires heating to high temperatures; col. 4, lines 32-42:

"The essence of this invention is the **application of liquid interface diffusion bonding to achieve metallic bonding of tubular products** within the **customary practices of hot rolling**. **LIDB requires temperatures above 1650° F., some contact pressure, and very clean conditions.** The nickel base alloy can not be exposed to air above 2200° F. For this reason, the subassembly is heated to a temperature at which the bonding metal alloy 12 melts, which is in the range of about 1650° F. to 2100° F. When the bonded metal alloy is nickel phosphorus, the

subassembly is heated to about 1950° F."

Reference to the hot rolling step is limited to the disclosure in col. 4, lines 43-52:

"In the exemplary application of the invention wherein a cladded pipe is manufactured on a mandrell mill, a mandrel is inserted into the heated subassembly and pressure is applied between the tubular cladding member 14 and host member 10 to metallically bond the two materials together; that is, after the subassembly is heated to the required temperature. It is hot rolled by a bank of opposing rolls to metallically bond the cladding member 14 to the host member internal surface 10A. The host member is now internally clad."

The hot rolling process disclosed in U.S. 4,794,471 effects a metallic bond by means of a **bonding alloy** between the two annular members wherein the alloy is melted and then under pressure alloyed with the two tubes to form a metallic bond. This process is described as liquid interface diffusion bonding. Note that the rolling step is a radial rolling step and not an axial rolling step: the forces applied by the bank of opposed rollers act in the radial direction to widen the inner ring but no axial flow of material occurs. The rollers have no profile or contour.

According to the present invention, there is no plating on the inner surface of the outer cylindrical workpiece in order to provide a metallic bond by liquid interface diffusion bonding.

The cited reference U.S. 4,794,471 based on its disclosure relating to a complex and labor-intensive very specific process using a hot rolling method cannot provide a teaching or motivation to apply the hot rolling bank of opposed rollers to a cold rolling method as used in U.S. 4,189,618. The cited reference employs as a basic technology alloys in order to produce the joints between the two workpieces by so-called LIDB (liquid interface diffusion bonding) and must therefore heat the workpieces. The use of a bank of opposed rollers in the context of a hot rolling process and in the context of a liquid interface diffusion bonding with its complicated set-up cannot suggest the use of such rollers in axial roll forming in a cold forming method. The examiner assertion that it is obvious to employ the teaching of the cited reference U.S. 4,794,471 because an

excellent metallic bond between the workpieces would be achieved does not hold true because the "excellent metallic bond" is achieved only by the use of a bonding alloy that is heated and hot rolled in the liquid state in an inert gas atmosphere between the two workpieces.

Applicant would also like to submit that the cold-formed aluminum layer that according to the present invention is to provide a connection in accordance with claim 19 between the workpieces is not comparable to the bonding alloys that must be heated and melted in accordance with U.S. 4,794,471.

Therefore the claims are not obvious in view of the cited art. Reconsideration and withdrawal of the rejection of the claims under 35 USC 103 are respectfully requested.

CONCLUSION

In view of the foregoing, it is submitted that this application is now in condition for allowance and such allowance is respectfully solicited.

Should the Examiner have any further objections or suggestions, the undersigned would appreciate a phone call or **e-mail** from the examiner to discuss appropriate amendments to place the application into condition for allowance.

Authorization is herewith given to charge any fees or any shortages in any fees required during prosecution of this application and not paid by other means to Patent and Trademark Office deposit account 50-1199.

Respectfully submitted on Dezember 2, 2009,

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